SCAG SB 375/SCS Technical Methodology and Related Processes for Estimating GHG Emissions

Prior to a Metropolitan Planning Organization (MPO) formally taking credit for implementing the public participation plan required by SB 375, the MPO must submit to the California Air Resources Board (ARB) a description of the technical methodology it intends to use to estimate the greenhouse gas (GHG) emissions from its Sustainable Communities Strategy (SCS) and, if ~~appropriate~~necessary, its Alternative~~e~~ Planning Strategy (APS). SB 375 encourages the MPO to work with the ARB until the ARB Board concludes that the technical methodology operates accurately. [Government Code Section 65080(b)(2)(I)(i)]

The following outlines SCAG's ~~comprehensive~~ technical methodology for implementation of SB 375 for the SCAG region. As described below, SCAG's comprehensive technical methodology exists in tandem with the outreach, planning, forecasting, and the iterative scenario development process described below.

SCAG's comprehensive technical methodology for SB 375 implementation consists of the following elements:

A) Analysis Years
B) Bottom-Up Process and Outreach/Stakeholders Input
C) Data Development for SCS
D) Sustainable Community Strategies
E) Models and Tools
F) Technical Methodology

A detailed description of each of these elements is provided in the following sections.

A) Analysis Years

For the purposes of SB 375 analyses, the Regional Targets Advisory Committee (RTAC) recommends a base year of 2005. As a result, MPOs would be required to achieve per capita emissions reductions equivalent to some percentage below their 2005 per capita levels by 2020 and 2035.

~~Since the 2008 Regional Transportation Plan (RTP) used 2003 as the base year and the 2012 RTP will utilize 2008 as the base year (pursuant to federal requirements for using latest planning assumptions),~~ SCAG will interpolate 2005 data for SB 375 target setting and recommendation purposes. This methodology was discussed and agreed upon by RTAC at their September 16, 2009 meeting. Table 1 on the next page summaries all the analysis years and their purposes for SB 375.

Table 1
Analysis Years for SB 375

YEAR	PURPOSE
2003	Used with 2008 to interpolate 2005
2005	Base year for SB 375 target setting
2008	Used with 2003 to interpolate 2005
2020	SB 375 GHG target year
2035	SB 375 GHG target year and 2012 RTP horizon year

B) Bottom-Up Process and Outreach/Stakeholder Input

A collaborative and inclusive bottom-up process ~~built upon mutual respect and trust~~ is the key to ensure a successful development of SCAG region 2012 Regional Transportation Plan (RTP) and SCS. With this principle, following are the major tasks and associated objectives that SCAG ~~have~~ has undertaken since 2008 to move the process forward to address the requirements of SB 375.

1. Program Setup

- Conduct SB 375 Workshops throughout the region and provide information on requirements and concepts of SB 375, plus the Conceptual Land Use Scenario exercise
- Conduct ~~Initial~~ initial outreach strategy kick-off
- Develop and adopt Guidelines and Public Participation Plan
- Gather response from subregions on development of optional subregional SCS
- Finalize roles and responsibilities among regional partners, particularly subregions and County Transportation Commissions (CTCs)~~.~~

2. GHG Target Development

- Determine and review RTP base year (2008) condition
- Develop 2005 base year ~~developed~~ via interpolation
- Develop Trend Baseline growth projections for 2020 and 2035 and ~~adjust 2008 RTP transportation network (to~~ account for impact of the economic downturn and associated revenue shortages on the adopted 2008 RTP~~)~~
- Review and gather local input on general plans including growth forecast/distribution and land use for 2020 and 2035
- Develop a range of scenarios
- Conduct Target-setting ~~subregional~~ Subregional Roundtables with stakeholders
- Develop GHG target (range) recommendation to ARB

3. Draft RTP/SCS Development

- Continue to collect input on additional local planning efforts
- Outreach to develop policy assumptions for Draft RTP/SCS
- Incorporate subregional SCSs, ~~if any~~as appropriate
- Perform technical analyses, including quantification of GHG reductions projected to be achieved by the SCS
- Develop Draft RTP/SCS

4. Final RTP/SCS Development and Approvals

- Develop Final RTP/SCS
- SCAG Regional Council Approval
- Regulatory approvals

C) Data Development for SCS

1. Socio-Economic Growth Forecast

The process for developing growth and economic forecasts includes:

- ~~Initiating~~ Initiate the SB 375 and 2012 RTP/SCS growth forecasting process (commenced October 2008)
- ~~Convening~~ Convene a panel of experts for technical assistance and advisory role (May 2009 and will continue through the 2012 RTP/SCS process)
- ~~Producing~~ Produce range of growth forecasts
- Build~~ing~~ teams to conduct one-to-one meetings with local jurisdictions/subregions and all major stakeholders (August 2009 – present).
- ~~Continuing~~ Continue local and subregion review, comment, and input
- ~~Releasing~~ Release draft growth forecasts
- Adopt~~ing~~ final forecasts as part of SCS

2. 2012 SCS/RTP Datasets and Trend Baseline

To meet the requirements of SB 375 in developing a SCS by 2012, the following datasets will be developed in collaboration with subregions, local jurisdictions, and CTCs (Figure 1):

1. 2005 base year developed through interpolation for SCS target setting and recommendation
2. 2008 base year for 2012 RTP
3. Trend baseline growth distribution and underlying land uses
4. General plan based growth forecast and distribution
5. Policy Forecast/SCS

The "trend baseline" illustrates the most likely outcomes of growth distribution and land use in the absence of recent policy intervention, allowing the region and its jurisdictions to take credit for actions and policies adopted recently or in the near future. While the "trend baseline" is a

technical projection that provides a best estimate of future growth based on past trends and assumes no recent general plan land use policies, the Policy Forecast/ SCS is derived using local input regarding their general plan land use strategies through a bottom up process, and also reflecting additional local planning and regional policies.

~~The "trend baseline" illustrates the most likely outcomes of growth distribution and land use in the absence of recent policy intervention, allowing the region and its jurisdictions to take credit for actions and policies adopted recently or in the near future. The "trend baseline" will be developed by extrapolating land uses and development patterns recently experienced across the region.~~

Figure 1. Draft 2012 RTP Growth Forecasts: Milestones and Timeline

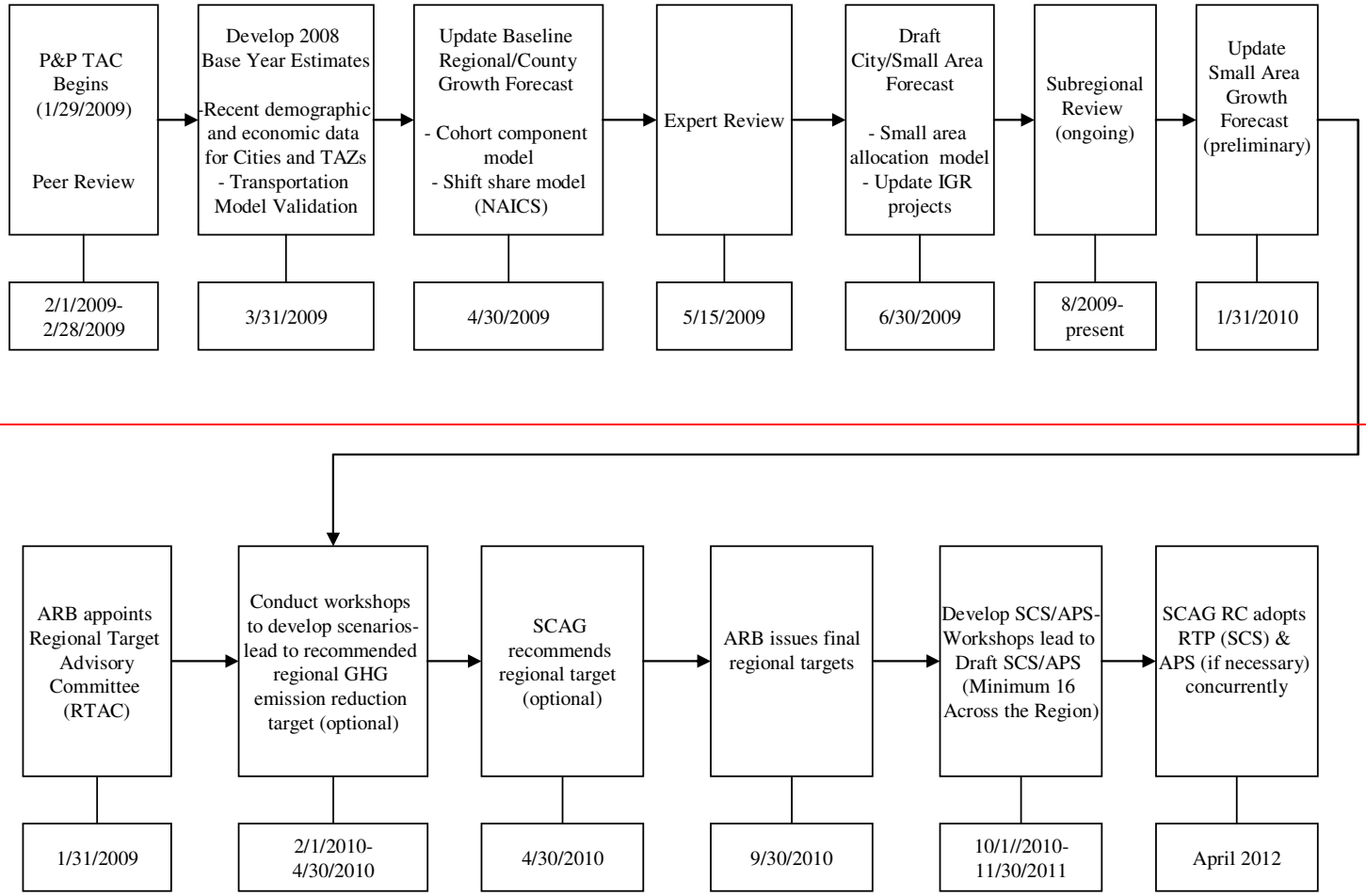
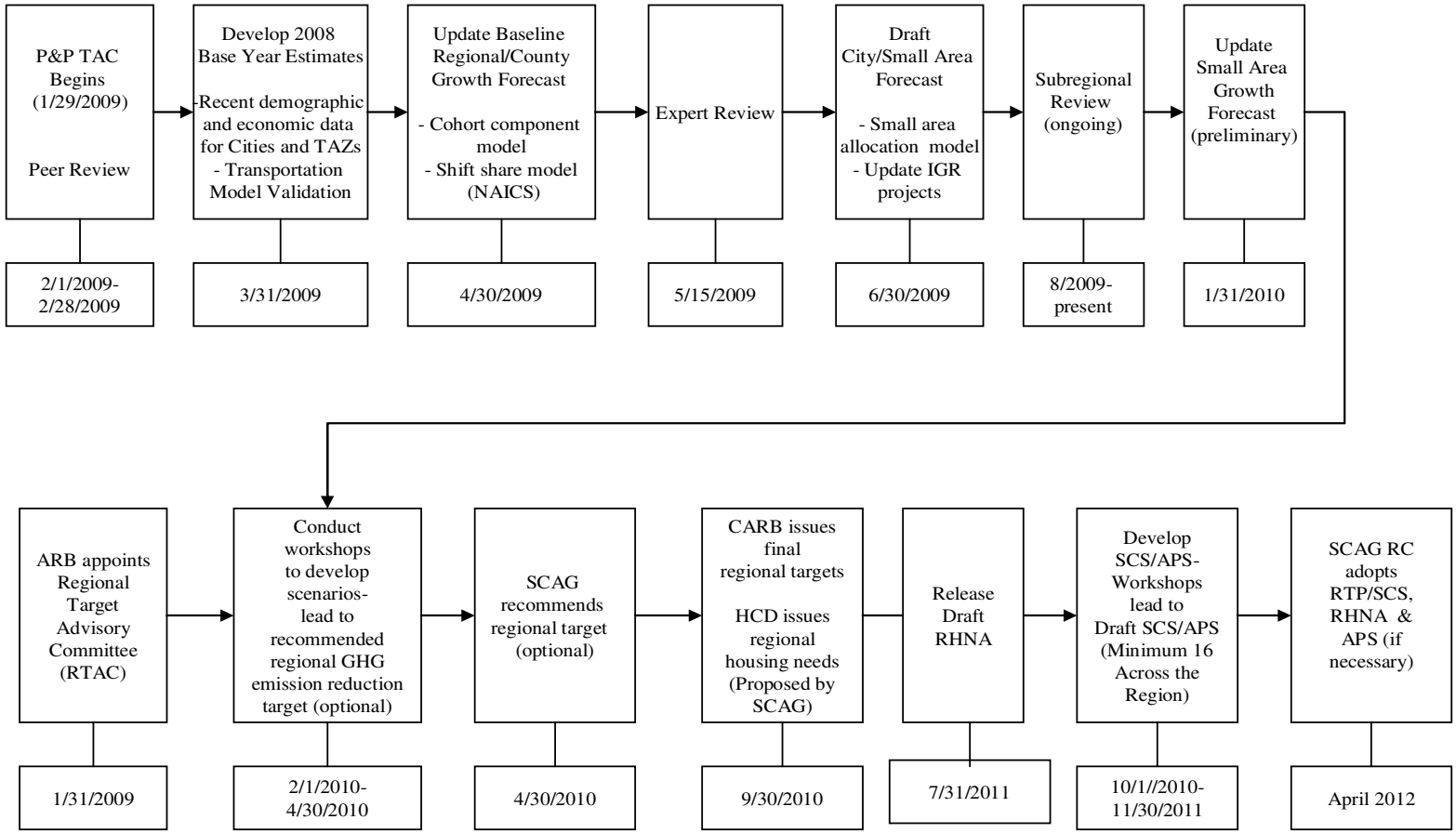


Figure 1. Draft 2012 RTP Growth Forecasts: Milestones and Timeline



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3. Data and GIS Maps

Data/GIS maps have been provided to subregions and local jurisdictions for their review. These data include the 2008 base year population, employment, households, and housing units estimates and their projections for 2020 and 2035. GIS maps include existing land use for 2008, the general plan land use and zoning, the resource areas, and other important areas identified in SB 375.

The list of data/GIS maps include:

1. Existing land use (2008)
2. General plan land use and zoning
3. Resource areas include:

   (a) All publicly owned parks and open space;

   (b) Open space or habitat areas protected by natural community conservation plans, habitat conservation plans, and other adopted natural resource protection plans;

   (c) Habitat for species identified as candidate, fully protected, sensitive, or species of special status by local, state, or federal agencies or protected by the federal Endangered Species Act of 1973, the California Endangered Species Act, or the Native Plan Protection Act;

   (d) Lands subject to conservation or agricultural easements for conservation or agricultural purposes by local governments, special districts, or nonprofit 501(c)(3) organizations, areas of the state designated by the State Mining and Geology Board as areas of statewide or regional significance pursuant to Section 2790 of the Public Resources Code, and lands under Williamson Act contracts;

   (e) Areas designated for open-space or agricultural uses in adopted open-space elements or agricultural elements of the local general plan or by local ordinance;

   (f) Areas containing biological resources as described in Appendix G of the CEQA Guidelines that may be significantly affected by the sustainable communities strategy or the alternative planning strategy; and

   (g) an area subject to flooding where a development project would not, at the time of development in the judgment of the agency, meet the requirements of the National Flood Insurance Program or where the area is subject to more protective provisions of state law or local ordinance.
4. Farmland
5. Spheres of influence
6. Transit priority areas

7. City/Census tract boundary with ID
8. City/TAZ boundary with ID

4. Relationship to Regional Housing Needs Assessment

SB 375 requires that the RHNA allocated housing units be consistent with the development pattern included in the SCS. *See*, Government Code §65584.04(i). Population and housing demand must also be proportional to employment growth. At the same time, in addition to the requirement that the RHNA be consistent with the development pattern in the SCS, the SCS must also identify areas that are sufficient to house the regional population by income group through the RTP planning period, and must identify areas to accommodate the region's housing need for the next local Housing Element eight year planning period update.

By State law, SCAG will be adopting the RHNA by 2012 and applying it to local jurisdictions at the jurisdiction boundary level. SCAG staff believes that consistency between the RHNA and the SCS may be accomplished by aggregating the housing units contained in the smaller geographic levels noted in the SCS and including such as part of the total jurisdictional number for RHNA purpose. SCAG staff has concluded that there is no consistency requirement for RHNA purposes at sub-jurisdictional level.

D) Sustainable Communities Strategies (SCS)

1. Land Use Component

The growth distribution, for SCS purposes, is the adopted growth forecast used for the RTP. SB 375 requires that this forecast be developed in such a way that it demonstrates reduced GHG emissions due to land use strategies as compared to the baseline scenario or the "trend baseline" as previously described. The trend baseline is intended to represent the most likely growth distribution in absence of the land use strategies.

In previous RTPs, land use scenario exercises to test the effectiveness of various land use strategies on VMT (and resulting GHG) reduction showed considerable promise in achieving that goal. SCAG will work with its member cities and other stakeholders to develop a range of potential land use strategies for consideration in ~~the final~~ SCS development. Each of these strategies will be included in one or more draft scenarios and GHG emissions will be quantified. Prior to incorporating any strategies into a final SCS, SCAG, in consultation with the applicable local government, will determine the political and market feasibility of said strategy.

2. Transportation Investment

The transportation network consists of the existing and planned transportation projects. SB 375 requires that certain transportation planning and programming activities ~~these projects~~ be "consistent" ~~(with some exceptions based on grandfathering provisions in the law)~~ with the SCS (with some exceptions based on grandfathering provisions in the law). In other words, the development of the future transportation network should proceed in such a way that it ~~serves~~ complements the anticipated growth strategy and distribution reflected in the SCS.

Development of a SCS presents an ~~unique~~ opportunity to develop ~~enhanced~~ approaches to system management and operational improvements, implementing pricing policies, and improving the coordination between transit services and non-motorized transportation, with the goal of creating more livable communities. These efforts assume ~~will require extensive~~ collaboration and voluntary participation among subregional stakeholders and CTCs in order to derive higher performance from the transportation system.

3. Transportation Demand Management / Transportation Systems Management

In addition to transportation projects, the RTP contains policies such as Transportation Demand Management (TDM) or Transportation System Management (TSM) policies. These include pricing, ride sharing, smart shuttles, preferential parking, freeway metering, etc. These policies can be layered with the other major elements of the SCS. It is anticipated that TDM/TSM policies will be of particular use in locales that do not have substantial existing or planned transit infrastructure.

4. Other Economic Factors & Principles

- Align economic development with the land use and transportation investment strategies
- Promote job-housing supply balance
- ~~Address the effects of fiscalization of land use~~
- Develop a "Land-use Strategy" that market ~~will~~ wants and can deliver

5. Subregional SCSs

SB 375 allows for subregional councils of governments in the SCAG region to have the option to develop the SCS, and the APS if necessary, for their area. Subregional agencies were requested to ~~must formally~~ indicate to SCAG, ~~in writing,~~ by December~~,~~ 2009, if they intended to exercise this option to develop their own SCS. Subregions that choose to develop a SCS for their area must do so in a manner consistent with Framework and Guidelines prepared by SCAG pursuant to SB 375. To date the ~~County of~~ Orange County Council of Governments (OCCOG)/Orange County Transportation Commission (OCTA) and the Gateway Council of Governments have indicated their intent to exercise this option~~accepted delegation~~.

SCAG will accept and incorporate a subregional SCS, unless (a) it does not comply with SB 375, (b) it does not comply with federal law, or (c) it does not comply with the adopted Subregional Framework and Guidelines. In the event that a compiled regional SCS, including subregional submissions, does not achieve the regional target, SCAG will initiate a process with partners to develop and consider additional GHG emission reduction measures region-wide.

SCAG assumes ARB will recognize and grant "credit" for business and city requested voluntary efforts to reduce GHG as part of the SCS. One example may be clean fuel fleets above and beyond AB 32 requirements.

6. Local Voluntary Efforts

In estimating emissions benefits from an SCS, the region may account for local voluntary efforts that result in reduced vehicle GHG emissions not limited to strategies aimed at reduced VMT.

Examples of such efforts may include local neighborhood electric vehicle programs or local incentives for the purchase or use of electric or other alternative fuel vehicles (e.g. preferential parking). Any local voluntary effort to reduce emissions that is accounted for in the SCS should demonstrate additional benefits beyond what is already required in State law.

In accounting for the benefits of such efforts, SCAG may rely on any local analysis to determine emissions savings. In lieu of locally derived data, SCAG may estimate emissions benefits by determining incremental improvements relative to what is derived from ARB's GHG emission methodology.

E) Models and Tools

1. Trip-Based Regional Transportation Demand Model

Until fully functional activity-based ~~transportation~~ travel demand models are developed and validated to be used for RTP purposes, SCAG's existing trip-based regional transportation demand model represents the current state-of-the-practice modeling tool. Although SCAG's trip-based model is the most comprehensive model in use, SCAG is undertaking model improvements and enhancements over the next two years. The major enhancements include updates to the vehicle ownership model, trip distribution and mode choice model, heavy-duty truck model, highway and transit networks, freeway and arterial speed studies, and enhancement of sensitivity to potential SCS strategies such as pricing and transit-oriented development strategies.

The trip-based regional transportation demand model consists of four major model components:

- Trip Generation - how often do people travel, for what purpose and at what time; how many workers are drawn to a given employment center
- Trip Distribution - where do people travel to work, school, and for other activities
- Mode Choice - how many people drive alone, share a ride, walk and bike, or take transit
- Network Assignment - what routes do people use and how much congestion do they experience

The model calculates vehicle miles and vehicle hour travelled (VMT and VHT), speeds and delay, and other performance measures for both passenger car and heavy duty vehicles. The enhanced regional model will utilize Census Block Group (10,569 in SCAG modeling area) as the analysis unit for most model components. The inter-regional and ports related travel are also included in the model. Attachment A describes the SCAG regional travel demand modeling process in detail.

2. PECAS Land Use / Economic Model

SCAG is in the process of developing a land use model, known as the PECAS (Production, Exchange, Consumption, Allocation System) Land Use Model, as are other MPOs and entities within the State. Land use models are intended to predict economic activity over a geographic space, such that land uses associated with economic activity can ~~also~~ be assessed ~~predicted~~from changes in transportation investment and policies. The effects of transportation ~~policies~~ and land use policy changes will be assessed through ~~ies~~ interactions and ~~with~~ feedbacks in an integrated transportation model and land use model system. ~~set.~~

3. Activity-based Travel Demand Model

Activity-based travel demand model is based on the concept that travel is a derived demand for activity participation. This approach predicts passenger trip travel demand based on assumptions of travel behavior and, unlike the trip-based model, takes trip chaining (e.g. home to work to day care to home) into consideration.

The model will create activity-based origin and destination (O&D) tables for passenger trips that replace the trip generation, trip distribution and mode choice tables for these trips in the trip-based model. O&D tables for other trips such as heavy-duty trucks, airport ground access trips, and trips into and out-of the region, would be combined with the passenger O&D from the activity-based model and then run through the trip assignment step from SCAG's existing trip-based travel demand model.

4. Local Sustainability Tool

SCAG is developing a GIS-based tool which will be made available to subregions and local governments for their use in subregional strategy development. This tool is intended to accomplish the following:

- Help local planners visualize their ~~thinking~~ process as related to various land use strategies, and see the effects of certain policy choices "on the ground";
- Display instant results estimating directional and order-of-magnitude VMT and emission reductions as result of community design, and other land use decisions made by stakeholders; and
- Be scalable to various geographic levels.

Figure 2 on the next page depicts the input, process, and output of the Local Sustainability Tool.

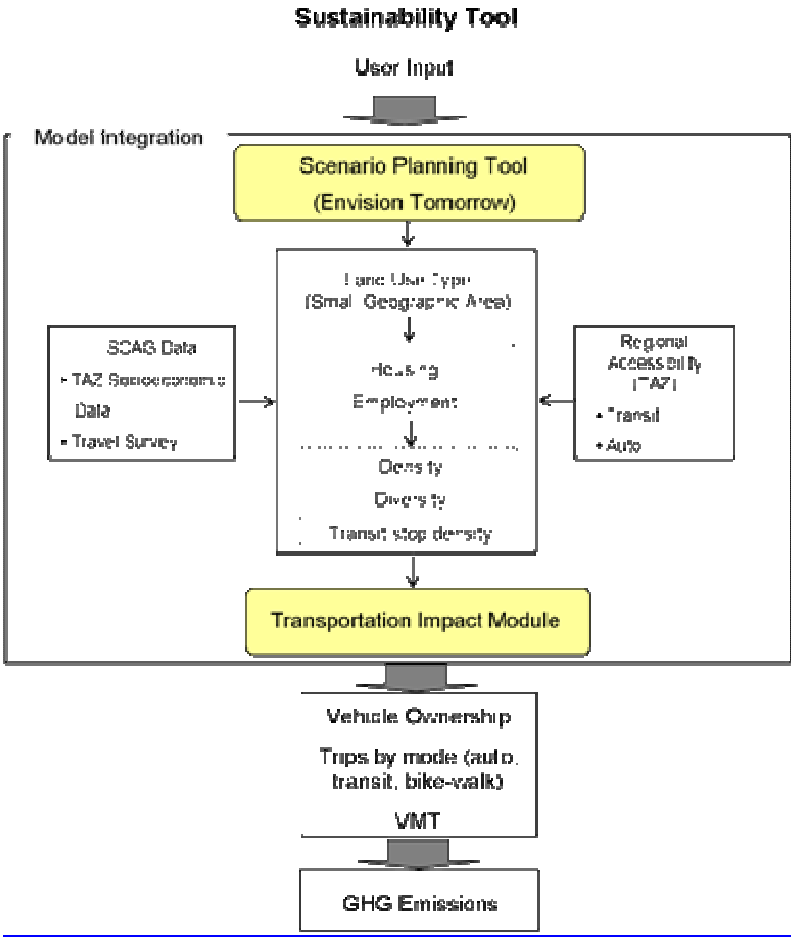
5. EMFAC

The ARB's EMFAC (short for "EMission FACtor") model ~~-~~is a computer model capable of estimating both current year, as well as back-cast and forecasted emission inventories for calendar years of 1970 to 2040. EMFAC estimates the emission rates of 1965 and newer vehicles, powered by gasoline, diesel or electricity. Emissions inventory estimates are made for over one hundred different technology groups and are reported for ten broad vehicle classes segregated by usage and weight.

EMFAC calculates the emission rates of HC, CO, NOx, PM, lead, SO2 and CO2 for 45 model years for each vehicle class within each calendar year, for twenty four hourly periods, for each month of the year, for each district, air basin, county and subcounty in California. EMFAC can report the gram per mile emission rates of a single technology group or the ton per day inventory for the entire 28,000,000 vehicle California fleet.

To determine regional and air basin emissions, SCAG runs the ARB's EMFAC model using the outputs from the trip-based regional transportation demand model.

Figure 2



6. Policies and Practices ~~as a Tool~~

~~The RTAC supports the use of accepted "Best Management Practices," currently referred to as "Policies and Practices,"~~ The concept of "Policies and Practices" has been put forward by ARB to provide MPOs flexibility in taking GHG emission reduction credit for efforts not readily quantified with conventional tools and models. As set forth in the RTAC report, the "Policies and Practices" are~~as~~:

- One of several resources to be used in target setting;
- A component of GHG reduction strategy development;
- A means to facilitate public review of the GHG reduction strategy for all MPOs;
- A means of target compliance demonstration by small MPOs in the first round and as an action plan to supplement model compliance by all MPOs; and
- An accuracy check tool for use by ARB as part of its strategy approval process.

In addition to providing subregional "Policies and Practices" scenario testing capabilities through the Local Sustainability Tool, SCAG will develop a list of regional "Policies and Practices." The SCS and/or APS will incorporate ~~the~~ applicable "Policies and Practices" either through modeling or off-model analyses. Examples of ~~Regional~~ Policies and Practices include: ~~rail system expansions, local bus systems improvements (e.g., expanded lines, increased headways), freeway and ramp metering, speed reduction/limit strategies, park and ride facilities and transit feeders, preferential/free/low-cost parking for carpoolers and parking pricing and vehicle trip reduction ordinances at regional employment centers, comprehensive telecommuting and satellite office programs~~transit-oriented development, pedestrian networks, bike programs, flexible work hours/telecommuting, etc.

7. REMI Model

As in the previous RTP development process, SCAG will conduct an economic impact analysis for the 2012 RTP and its major policy components. For the 2012 RTP and SCS, SCAG will use the REMI regional economic model for the socioeconomic impact analysis. The economic impact analysis/report will focus on Region-wide employment, income, economic output, productivity impacts, and local government finance from impacts of major policy components, including land use, transportation investment, TDMs/TSMs, pricing, and others.

In addition, the economic impact analysis will attempt to measure those not-normally-estimated benefits associated with change in development patterns. Among them, energy savings resulting from less water usage and its transport; impacts on urban/suburban run-offs and water quality due to impacts on pervious and impervious lands; and various health impacts from different built environment and community design.

8. Peer Review Process

SCAG has embarked on a ~~very ambitious~~ program to update the existing transportation model and to develop next generation activity-based and land use models. SCAG's goal is to have state-of the-art modeling capabilities. A model peer review program has been integrated into SCAG's model development process to ensure the new tools meet performance expectations and to increase overall model credibility. Expert panel reviews have been included in each of SCAG's major model improvement programs. To date, separate expert panel reviews have been

conducted on the Regional Growth Forecast, the Heavy-Duty Truck Model and the pricing component of the model. Recommendations from these panels have been integrated into the consultant scopes of works to refine the model development efforts. A full peer review will be conducted on the final modeling system that will be used in the Year 2012 RTP/SCS analysis.

F) Technical Methodology

The methodology for estimating transportation-related GHG emissions associated with regional growth scenarios is primarily based on SCAG's trip-based regional transportation demand model and the ARB's EMFAC model. Once completed (that is, calibrated and validated), SCAG's land use model will be used to develop scenario land use data, and the activity-based model will be used in the SCS scenario analysis. The methodology steps are described below.

1. Develop land use portion of SCS~~.~~

Growth forecasts, particularly the local input based growth forecasts, will be developed based on SCAG's bottoms-up integrated growth forecasting process and will be used as ~~follow the SB 375 procedures serving as~~ the basis and starting point to develop ~~for developing~~ the SCS. This dataset may or may not achieve the GHG reduction target set by ARB. If additional strategies are necessary to achieve the target, SCAG will work with its member cities and other stakeholders to develop a range of potential land use strategies for consideration in SCS development. Each of these strategies will be included in one or more draft scenarios and GHG emissions will be quantified to test their effectiveness. Prior to incorporating any strategies into a final SCS, SCAG, in consultation with the applicable local government, will determine the political and market feasibility of said strategy.

2. Identify related transportation investments/improvements and other SCS policies~~.~~

The regional SCS will identify and examine new investments in transportation facilities and improvements in TDM and TSM strategies as well as other relevant policies and strategies. These investments/improvements will be incorporated into the regional transportation demand model where feasible.

3. Analyze RTP/SCS through modeling

SCAG will use the draft versions of the Activity-based and PECAS land use models to test GHG emission reduction scenarios as appropriate. The SCS and alternatives scenarios will be used as input to the regional transportation demand model for RTP/SCS/conformity/CEQA analyses.

4. Use off-model analyses to estimate VMT changes or GHG reductions from land use, Policies and Practices, or other strategies if necessary~~.~~

Per the RTAC and~~/~~ ARB recommendations, SCAG will use off-model analyses as necessary and appropriate to account for ~~Policies and Practices~~ any voluntary efforts or other strategies that are not captured by the regional transportation demand model. The off-model analysis methodology will be informed by the on-going collaboration among MPOs and between MPOs and the ARB on this subject, as well as discussion with applicable technical working groups. SCAG anticipates that the off-model analysis technique will be primarily used for quantifying voluntary efforts from cities/counties and the business sector, and those policies and practices that are not readily applicable for modeling analyses.

5. Run ARB's EMFAC Model~~.~~

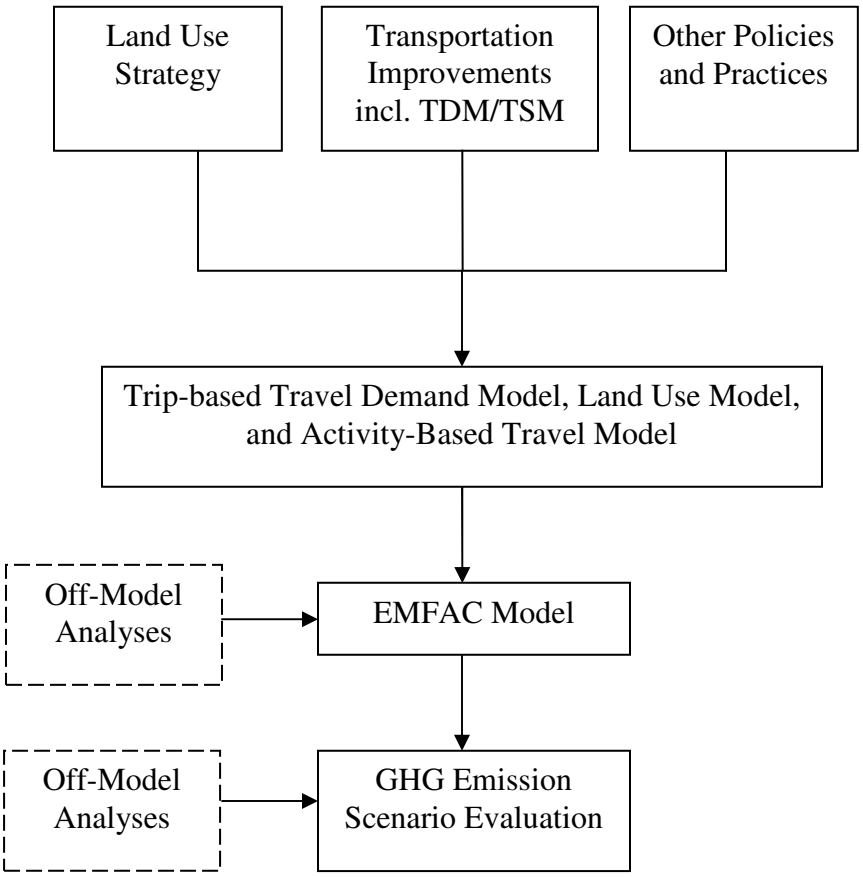
SCAG will run EMFAC for baseline and SCS scenarios in the appropriate milestone years. GHG emissions will be calculated based on ARB methodology for converting EMFAC emission outputs to CO2 equivalent emissions. Adjustments to EMFAC that account for recent state laws which reduce GHG emissions from passenger vehicles will be made per ARB direction.

6. Scenario Evaluation

Summarize and compare trend baseline and various SCS scenarios to demonstrate SCS benefits and its comparison with the GHG reduction targets against base year 2005.

The flow chart on the next page illustrates the proposed technical methodology for estimating GHG emissions.

Figure 3
Proposed Technical Methodology for Estimating GHG Emissions

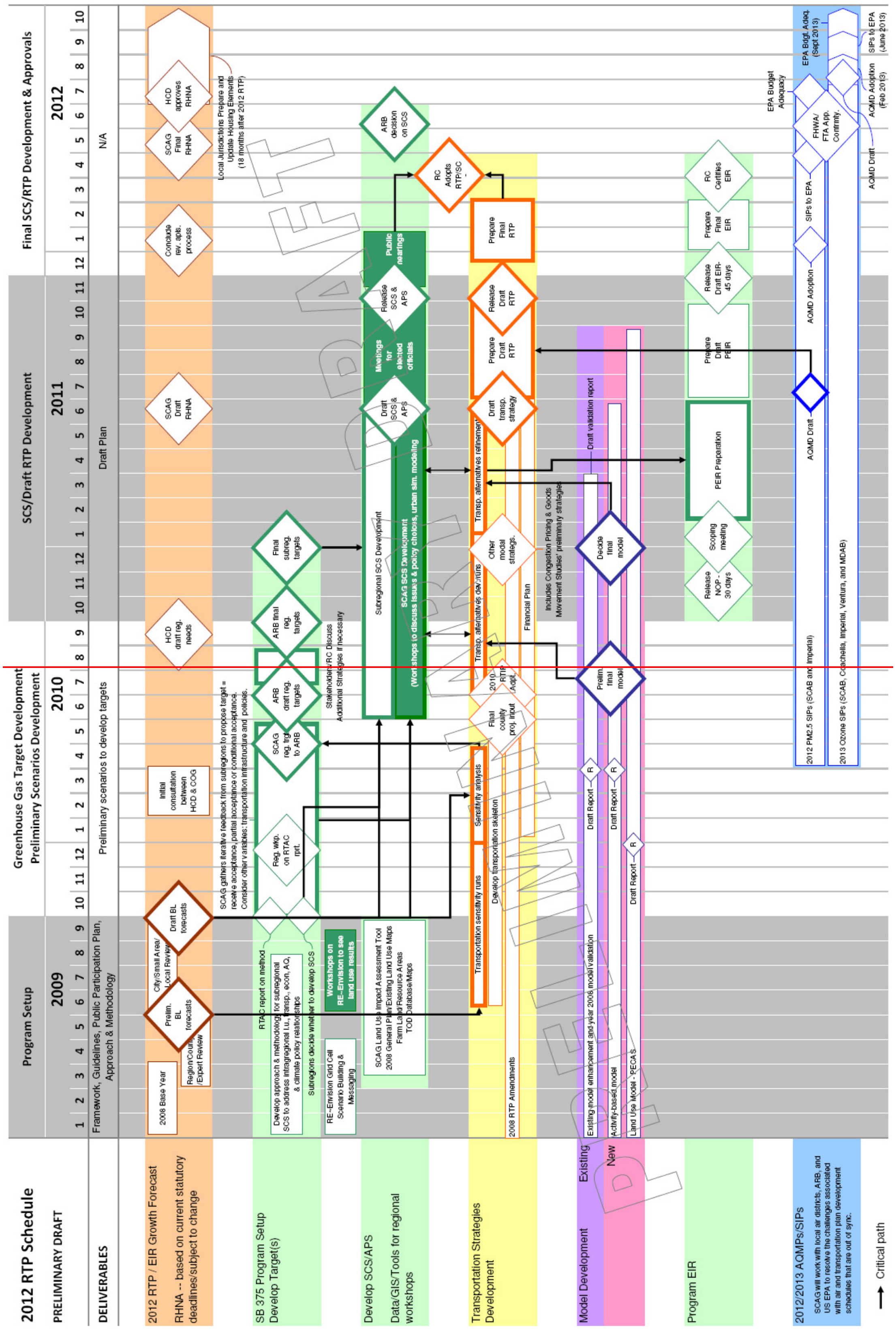


Following is a list of applicable milestones.~~The draft master schedule for the multiple planning processes relevant to RTP/SCS development is shown in Figure 4.~~

- ARB issues Final Regional Targets – September 2010

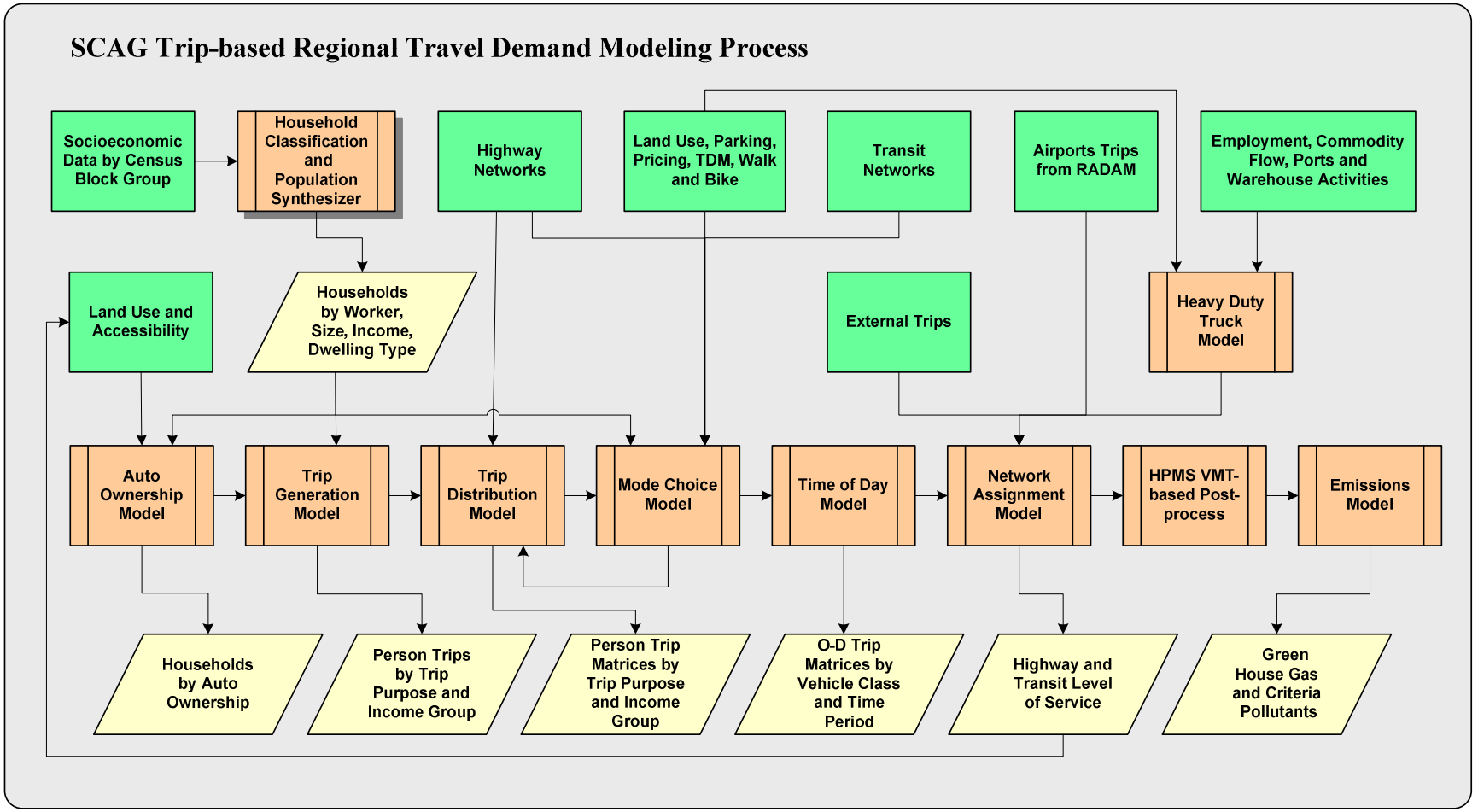
- SCS development (preliminary scenario, draft, etc) – through early 2011
- Release Draft RTP/regional SCS for public review – November 2011
- Regional Council adopts RTP/SCS – April 2012

~~**Figure 4**~~


2012 RTP Schedule
PRELIMINARY DRAFT
DELIVERABLES
Program Setup
Greenhouse Gas Target Development
Preliminary Scenarios Development
SCS/Draft RTP Development
Final SCS/RTP Development & Approvals
2009
2010
2011
2012
Framework, Guidelines, Public Participation Plan, Approach & Methodology
Preliminary scenarios to develop targets
Draft Plan
N/A
2012 RTP / EIR Growth Forecast
RHNA -- based on current statutory deadlines/subject to change
2008 Base Year
Region/County /Expert Review
Prelim. BL forecasts
City/Small Area/ Local Review
Draft BL forecasts
Initial consultation between HCD & COG
HCD draft reg. needs
SCAG Draft RHNA
Conclude rev. apls. process
SCAG Final RHNA
HCD approves RHNA
Local Jurisdictions Prepare and Update Housing Elements (18 months after 2012 RTP)
SCAG gathers iterative feedback from subregions to propose target = receive acceptance, partial acceptance or conditional acceptance. Consider other variables: transportation infrastructure and policies.
SB 375 Program Setup
Develop Target(s)
RTAC report on method
Develop approach & methodology for subregional SCS to address intragregional l.u., transp., econ, AQ, & climate policy relationships
Subregions decide whether to develop SCS
Reg. wkp. on RTAC rprt.
SCAG reg. trgt. to ARB
ARB draft reg. targets
ARB final reg. targets
Final subreg. targets
Stakeholders/RC Discuss Additional Strategies if necessary
RE-Envision Grid Cell Scenario Building & Messaging
Workshops on RE-Envision to see land use results
Develop SCS/APS
Data/GIS/Tools for regional workshops
SCAG Land Use Impact Assessment Tool
2008 General Plan/Existing Land Use Maps
Farm Land/Resource Areas
TOD Database/Maps
Subregional SCS Development
SCAG SCS Development
(Workshops to discuss issues & policy choices, urban sim. modeling
Draft SCS & APS
Meetings for elected officials
Release SCS & APS
Public hearings
ARB decision on SCS
RC Adopts RTP/SCS
Transportation Strategies Development
Transportation sensitivity runs
Sensitivity analysis
Develop transportation skeleton
2008 RTP Amendments
Final county proj. input
2010 RTIP Adpt.
Transp. alternatives dev./runs
Other modal strategs.
Transp. alternatives refinement
Draft transp. strategy
Prepare Draft RTP
Release Draft RTP
Prepare Final RTP
Financial Plan
Includes Congestion Pricing & Goods Movement Studies' preliminary strategies
Model Development
Existing
New
Existing model enhancement and year 2008 model validation
Draft Report
R
Activity-based model
Land Use Model - PECAS
Prelim. final model
Decide final model
Draft validation report
Program EIR
Release NOP - 30 days
Scoping meeting
PEIR Preparation
Prepare Draft PEIR
Release Draft EIR- 45 days
Prepare Final EIR
RC Certifies EIR
2012/2013 AQMPs/SIPs
SCAG will work with local air districts, ARB, and US EPA to resolve the challenges associated with air and transportation plan development schedules that are out of sync.
2012 PM2.5 SIPs (SCAB and Imperial)
AQMD Draft
AQMD Adoption
SIPs to EPA
FHWA/ FTA App. Conformity.
EPA Budget Adequacy
EPA Bdgt. Adeq. (Sept 2013)
2013 Ozone SIPs (SCAB, Coachella, Imperial, Ventura, and MDAB)
AQMD Adoption (Feb 2013)
SIPs to EPA (June 2013)
Critical path
PRELIMINARY DRAFT

Attachment A

Summary Description of SCAG Regional Travel Demand Modeling Process



Legend

Input Module Output

Note:
Population Synthesizer (shadowed) is a new component.
All the model modules and input data are updated for 2008 model validation and 2012 RTP analysis.

MODEL INPUTS AND ASSUMPTIONS

Socioeconomic Data by Census Block Group

Socioeconomic data, which describes population, households, and employment at Block Group level, are used as major input to SCAG's Regional Model. The concept is that travel is a derived demand of activity participation, which is directly related to the demographics and economic characteristics of households. The model uses both aggregate and disaggregate socioeconomic data (SED). The aggregate data are counts of population, households and employment for each Transportation Analysis Zone (TAZ). The disaggregate data are Public Use Microdata Sample (PUMS) records from Census, which contain detailed information about persons and households characteristics in the region.

Highway Networks

The highway networks were originally developed from the Thomas Brothers GIS database and then updated with street inventory survey data (the latest SCAG region street inventory survey was conducted in year 2008) in the TransCAD environment. The networks include detailed coding of the region's freeway system (mixed-flow lane, auxiliary lane, HOV lane, toll lane, truck lane, etc.) as well as arterials, major collectors, and some minor collectors. Separate highway networks for each time period were developed to simulate time of day differences in roadway capacity and vehicle travel restrictions, such as arterial parking restrictions during peak hours, HOV lane minimum vehicle occupancy requirement, and heavy-duty vehicle restrictions on certain roadways.

Land Use and Accessibility for Auto Ownership Model

Accessibility refers to the ease of reaching goods, services, activities, and destinations. Many factors affect accessibility, including the quality and affordability of transport options, transport system connectivity, and land use patterns. The auto and non-auto accessibilities of a zone directly influence household auto ownership. Land use patterns, in particular high density, mixed-use developments also directly influence household auto ownership.

Land Use, Parking, Pricing, TDM, Walk and Bike for Mode Choice Model

Land use, zonal parking, roadway pricing, and Travel Demand Management (TDM) are inputs to mode choice, in addition to the modal level of service obtained from the highway, transit, and non-motorized networks. ~~It is well known that p~~Parking fees/restrictions, road pricing cost/policies, and land use densities have direct influence on travelers' mode choice. For example, increasing parking fees encourages travelers to shift from auto to transit. Also, high employment and residential densities encourage the use of transit and non-motorized modes.

Transit Networks

The transit networks include more than 1,800 transit routes, representing approximately 130 transit carriers over the entire SCAG region. The transit routes are completely compatible with the highway geography. Separate transit networks are developed for five time periods based on the transit service information contained in the up-to-date Los Angeles County Metropolitan Transportation Authority (Metro) Transit TripMaster database and data collected from transit agencies not included in the TripMaster database. Transit services are grouped into 8 transit modes (Local Bus, Rapid Bus, Express Bus, BRT, Transit Way, Urban Rail, Commuter Rail, and High Speed Rail (HSR), according to their service characteristics and fare structures. The transit networks include detailed representation of all rail stations, transfer opportunities among the different modes and between transit routes and park-and-ride locations. A TeleAtlas street network along with Census Block level data is used to calculate walk accessibilities and to develop walk access to transit.

External Trips

External trips (i.e., inter-regional trips) are trips with one or both ends located outside the SCAG modeling area. SCAG model includes 40 cordon locations consisting of freeways and arterials leading into and out of SCAG modeling area. A cordon traffic origin-destination survey was conducted in year 2003 and the results were used to develop inter-regional Light and Medium (LM) duty vehicle trip matrices, including External-to-External (E-E), External-to-Internal (E-I), and Internal-to-External (I-E) trips. The origin-destination survey will be updated for the 2012 RTP.

Airports Trips from RADAM

Airports trips include passenger trips and cargo trips. Both airport passenger and cargo trip tables (about 100 zones for the SCAG modeling area) are obtained from the Regional Airport Demand Allocation Model (RADAM). The daily airport passenger trips from the RADAM model are then disaggregated into regional model TAZ (using employment data for business trips and household data for non-business trips) and further split into five time periods by four modes of travel: drive alone, 2-person carpool, 3-person carpool, and 4-or-more person carpool. The airport vehicle trips are merged with the other auto vehicle trips prior to the network assignment step. Similarly, the RADAM model generated air cargo truck trips at the RADAM zones. These trips are then disaggregated into the regional model TAZs based on the North American Industry Classification System (NAICS) employment data. The daily air cargo trips are split into five time periods by three truck types (light HDT, medium HDT, and heavy HDT) and merged with the HDT truck trips prior to network assignment.

Employment, Commodity Flow, Ports, and Warehouse Activities

These inputs to the transportation model are data related to the freight activities, including employment by industrial classification, commodity flows, seaports, warehousing, trucking and wholesale trade, etc. SCAG is in the process of updating the heavy duty truck model~~,~~.

MODEL MODULES AND PROCEDURES

Household Classification and Population Synthesizer

This module classifies zonal households into several household segments. Prior to the application of Auto Ownership module, households are classified across the following four attributes:

1) Household Size (4 categories): the number of one-person households, two-person households, three-person households, and four or more person households.
2) Number of Workers (4 categories): the number of households with no worker, with one worker, with two workers, and with three workers or more.
3) Household Income (4 categories): the number of households with annual household income (in 1999 dollars) less than $20K (Low), $20K-$50K (Medium), $50K-$100K (High), and $100K or more (Very High).
4) Type of Dwelling Unit (2 categories): single-family detached, and multi-family/attached and group quarters.

For Home-Based-Work (HBW) trip generation, households are aggregated across the dwelling unit type and size attributes, and then further disaggregated into four Age of Head of Household groups (18 to 24 years old, 25 to 44 years old, 45 to 64 years old, and 65 years old or older).

The Population Synthesizer is a module that generates a synthetic population by expanding the existing disaggregate sample data (from Census PUMS data) to mirror known aggregate distributions of household and person attributes (from SCAG zonal data). The control variables used in the population synthesizer are the above-mentioned four household variables. A synthetic population is generated for the entire SCAG region using this procedure.

Auto Ownership Model

The auto ownership model provides an estimate of households by auto ownership level (0, 1, 2, 3, 4 or more) for each zone. This information is used in trip generation models to estimate zonal person trips. The basic structure of the auto ownership model is a multinomial logit formulation, using input socioeconomic variables (household size, household income, number of workers, and type of dwelling unit) and land use and accessibility variables (mixed residential and employment, intersection density, transit accessibility, and non-motorized accessibility).

Trip Generation Model

Trip generation is the process of estimating daily person trips generated by (i.e., trip production) and attracted to (i.e., trip attraction) each TAZ on an average weekday. The trip generation model contains 9 trip purposes: home-based work (HBW), home-based school (HBSC), home-based college/university (HBCU), home-based shopping (HBS), home-based social-recreational (HBSR), home-based serving-passenger (HBSP), home-based other (HBO), work-based other (WBO), and other-based other (OBO) trips. HBW trips are further split into 8 types based on two trip categories ("Direct" versus "Strategic") and four income categories (less than $20,000, $20,000 to $49,999, $50,000 to $99,999, and $100,000 or more). "Direct" home-work trips go directly between home and work. "Strategic" home-work trips include one or more intermediate

stops between home and work. In total, there are 16 trip types: 8 types for home-based work, and one type for each of the other 8 trip purposes.

Trip Distribution Model

The trip distribution model estimates the number of trips from each TAZ to each other TAZ. Destination choice models are developed for HBW, HBS, HBSR, HBSP, HBO, WBO, and OBO trip purposes while a gravity model approach is used to distribute trips for HBSC and HBCU trip purposes. The trip distribution is estimated as a function of the attractiveness of the destination zone and the travel impedance from origin to destination. The destination choice models include other variables, such as intrazonal indicators, employment or residential density variables, and flags for special generators. For each of the 9 trip purposes, the productions and attractions are split into both peak and off-peak periods.

Mode Choice Model

Mode choice is the process of taking the zone-to-zone person trips by trip purpose from the trip distribution model, and determining how many of these trips are made by various travel modes. The SCAG mode choice model is a nested logit model. The top branch of the nesting structure includes Auto, Transit, and Non-Motorized. The branch under Auto includes Drive Alone and Shared Ride which is further split into 2-person carpool, 3-person carpool, and 4-or-more person carpool. The branch under Transit includes Local Bus, Rapid Bus, Express Bus, BRT, Transit Way, Urban Rail, Commuter Rail, and HSR. The branch under Non-Motorized includes Walk and Bicycle. Separate mode choice models are estimated for each trip purpose and time period. Mode choice is a function of level of service attributes (in-vehicle travel time, out-of-vehicle travel time, fares, parking fees, roadway tolls, auto operating costs), household attributes such as income, and zonal attributes such as residential and employment densities.

Heavy Duty Truck (HDT) Model

According to the California Air Resources Board (~~C~~ARB), a HDT is defined as a truck with a gross vehicle weight of 8,500 pounds or more. The SCAG HDT Model includes internal truck trip models and external truck trip models. The internal truck trips are generated using a cross-classification method by applying truck trip rates for a two-digit NAICS code by the number of employees in that category and also the number of households within each zone. The daily truck trip ends are distributed using a gravity model to create daily truck trips for each of the three truck types: 1) light HDT, 2) medium HDT, and 3) heavy HDT. The external truck trips are developed using an econometric model to estimate inbound and outbound commodity flows by counties. The county to county commodity data are allocated to the zonal level based on NAICS employee distribution and then converted to trucks trips using observed data collected during model development. Seaport and airport related truck trips were included as special generator truck trips. The daily truck trips by truck types are allocated to five time periods and merged with the auto trips in trip assignment.

Time of Day Model

The time of day model is used to allocate daily auto trips to five time periods of a day (AM peak: 6am-9am; Mid-day: 9am-3pm; PM peak: 3pm-7pm; Evening: 7pm-9pm; Night: 9pm-6am). It consists of discrete choice model with functions that consider the trip purpose, desired time of

travel, current time of travel, trip duration, flexibility in arrival and/or departure time, trip distance, and travel cost. The time of day model also converts person trip matrices in Production-Attraction (PA) format into vehicle matrices in Origin-Destination (OD) format.

Network Assignment Model

Network assignment is the process of loading vehicle trips on the appropriate networks. For highway assignment, the Regional Model consists of series of multi-class simultaneous equilibrium assignments for seven classes of vehicles (drive alone, 2-person carpool, 3-person carpool, 4 or more-person carpool, light HDT, medium HDT, and heavy HDT) and for each of the five time periods. During this assignment process, trucks are converted to Passenger Car Equivalent (PCE) for each link and each truck type based on 1) percentage of trucks, 2) percentage of grade, 3) length of the link, and 4) level of congestion (v/c ratios). Transit vehicles are also included in the highway assignment. For transit trip assignment, the final transit trips from the last loop mode choice models are aggregated by access mode and time period, and then assigned to transit networks for each time period. The vehicle trip tables obtained from mode choice, airport, and heavy duty models are aggregated to the 4,109 zone system (Tier-1 zones) prior to network assignment.

Model Convergence

In order to maintain consistency between the speeds predicted by the highway assignment and the travel times input to the entire travel demand model chain, the predicted speeds are used to re-compute highway and transit travel times, and the entire model sequence are repeated until input and output speeds are consistent with each other.

HPMS VMT-based Post-process

In this step, the outputs from the Network Assignment Model, which including traffic volumes, speeds, Vehicle Miles Traveled (VMT), Vehicle Hours Traveled (VHT), and Vehicle Hours of Delay (VHD) are adjusted so that the base-year model VMT by air-basin by county is consistent with Highway Performance Monitoring System (HPMS) VMT as appropriate. Additional adjustments might be needed based on off-model analysis of Sustainable Communities Strategy (SCS) related Policies and Practices prior to the application of the Emissions Model.

Emissions Model

SCAG uses the EMFAC model developed by ~~C~~ARB to calculate on-road motor vehicle emissions. In the EMFAC model, the emission rates from each of the motor vehicle types are multiplied with vehicle activity data to calculate on-road motor vehicle emissions. The activity data taken from the regional model outputs include 1) highway link information such as volumes, distance, and congested speed and 2) intra-zonal trips, average travel time and distance. The output pollutants are ROG, CO, NOx, CO2, PM10, PM2.5, and SOx. Fuel consumption is also calculated.

MODEL OUTPUTS

Population Synthesizer Outputs

The synthetic households by Number of Workers, Household Size, Household Income, and Type of Dwelling Unit, and a separate classification of households by Number of Workers, Age of Household Head, and Household Income are the outputs from the Population Synthesizer module and the inputs to the Trip Generation Model.

Auto Ownership Model Outputs

The auto ownership model generates households by auto ownership, in other words, the number of households with 0 car, 1 car, 2 cars, 3 cars, and 4 or more cars for each zone, which are the inputs to the Trip Generation Model.

Trip Generation Model Outputs

The output from trip generation model includes person trip tables by 9 trip purposes, of which HBW trips are further split into 8 types by 4 income groups and Direct/Strategic categories for both peak and off-peak periods. These 32 person trip tables are used individually in the Trip Distribution step.

Trip Distribution Model Outputs

The Trip Distribution Model distributes person trips from each trip production zone to each and every attraction zones, resulting in 32 person trip Production/Attraction (P/A) matrices, which are the inputs to the Mode Choice Model.

Mode Choice Model Outputs

The outputs from the Mode Choice Model are person trip P/A matrices by 9 purposes, 14 travel modes (Drive Alone, 2-Person Carpool, 3-Person Carpool, 4 or more Persons Carpool; Local Bus, Rapid Bus, Express Bus, Transit Way Bus, BRT, Urban Rail, Commuter Rail, High Speed Rail; Walk and Bike), and 2 time periods (peak and off-peak). They are the inputs to the Time of Day Model. The Mode Choice Model also splits toll and non-toll trips.

Time of Day Model Outputs

The outputs from the Time of Day Model include passenger vehicle trip matrices in OD format by time period and occupancy level. These matrices are then combined with external trips, airport trips, and HDT trips to produce final vehicle OD matrices (3 passenger vehicle classes and 3 HDT classes in 5 time periods) for Network Assignment step. The 3 passenger vehicle classes are drive alone, 2-person carpool, and 3-person carpool. The 3 HDT classes are light HDT, medium HDT, and heavy HDT. Transit person trips matrices for each of five time periods are also produced in this step for transit assignment.

Network Assignment Model Outputs

Major outputs of the Network Assignment model are highway and transit level of service attributes, including traffic flows and the associated speeds, VMT, VHT, and VHD on the

highway networks as well as transit boarding and passenger loads on each transit line for each time period.

Emissions Model Outputs

The outputs of the emissions model are the quantities of various pollutants including ROG, CO, NOx, CO2, PM10, PM2.5, and SOx.